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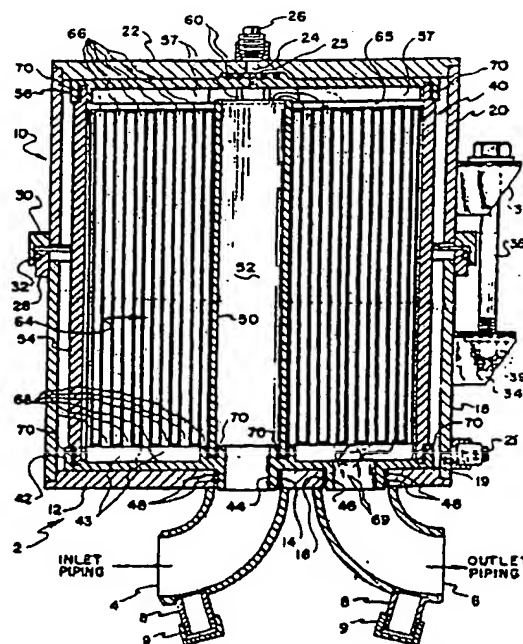
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(54) Title: **DRY SUMP LIQUID FILTER**

(57) Abstract

A liquid filter apparatus, for connection to inlet and outlet piping, (4, 6) includes a housing (10) which is integral with the piping and a removable integral filter unit (40) in the housing (10). The integral filter unit (40) includes bottom and top end caps (42, 56) with a core tube (50) and a concentric outer tube (54) extending between the end caps. A filter element (64) between the core tube (50) and the outer tube (54) stands on ribs (43) extending upward from the bottom end cap (42) and is spaced from the top end cap (56) by similar ribs (57) extending downward from the top end cap (56), these ribs (43, 57) creating radial flow channels above and below the filter element. The filter element (46) is wound spiral of filter material (62) and separator (63) forming a plurality of axial flow channels (66, 68). Some of these axial flow channels (66, 68) are open at the top to receive liquid from the top radial flow channel and closed at the bottom, and some of the axial channels (66, 68) are closed at the top and open at the bottom to discharge liquid into the bottom radial flow channel. Filter action is by way of radial flow, through the filter material, (62) from the open-top channels to the open-bottom channels. The housing cover (22) is removable to remove and replace the filter (40). Means (26) are provided to vent air from the system and to drain liquid from the system for removal and replacement of the filter (40) without having to clean the housing (10).



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DRY SUMP LIQUID FILTERBACKGROUND OF THE INVENTIONField of the Invention

This invention relates to a liquid filter and
5 housing allowing replacement of the filter element without
spillage because the dry housing is not part of the filter
fluid path.

Description of the Prior Art

Most liquid filters are installed by the user in
10 a steel housing which is a part of the filter and of the
liquid path through it. Such a prior art housing typically
has inlet and outlet pipe connections and is a pressure
vessel with a heavy cover clamped in place. For filtering
viscous liquids, the clean-up of the conventional stainless
15 steel housing is arduous; and the use of a stand-alone
throw-away filter directly connected to inlet and outlet
lines may not be allowable if certain hazardous solvents
are involved.

In the prior art, United States Patent 1,896,310
20 to Hildebrand discloses a stand-up water filter having a
cylindrical filter element which operates in a filter mode
when one faucet is open and in a flush mode when another
faucet is open. An outer shell 1, which is apparently only
an aesthetic cover, surrounds an inner shell 4, which is
25 the operative fluid flow housing.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a
dry sump housing and filter unit in which the housing has
permanently piped inlet and outlet connections, and the
30 inside of the housing remains dry and requires little if
any clean-up and permits replacement of the filter element
without spillage of liquid.

The invention may be summarized as a liquid
filter apparatus, for connection to inlet and outlet
35 piping, and including a housing which is connected to the
piping and a removable filter in the housing. The filter
includes bottom and top end caps, with a core tube and a
concentric outer tube extending between the end caps. A

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filter element between the core tube and the outer tube stands on ribs extending upward from the bottom end cap and is spaced from the top end cap by similar ribs extending downward from the top end cap, these ribs creating radial flow channels above and below the filter element. The filter element is a wound spiral of a sandwich including a flat filter sheet material and a corrugated polymeric separator sheet forming a plurality of axial flow channels. Some of these axial flow channels are open at the top to receive liquid from the top radial flow channel and closed at the bottom, and some of the axial channels are closed at the top and open at the bottom to discharge liquid into the bottom radial flow channel. Filter action is by way of radial flow, through the filter material, from the open-top channels to the open-bottom channels. The housing cover is removable to remove and replace the filter. Means are provided to vent air from the system and to drain liquid from the system for removal and replacement of the filter.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional elevation view of the filter and housing of this invention.

Figure 2 is a schematic top view, somewhat enlarged, of a filter element according to this invention.

Figure 3 is a still further enlarged schematic detail of FIG. 2.

Figure 4 is a bottom view of the top end cap.

Figure 5 is a top view of the bottom end cap.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, the housing and filter combination of this invention, generally indicated at 2, includes a housing 10 supporting and enclosing a filter 40. Housing 10 is a permanent fixture, connected to inlet piping 4 and outlet piping 6, each of these having a capped drain fitting 8. Housing 10 includes a base plate 12, which is welded to the inlet and outlet piping and is apertured at 14, 16 in registry with that piping. The side wall of housing 10 includes a lower housing section 18 and

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an upper housing section 20. A cover plate 22, having a central vent aperture 24 and a vent fitting 26, is welded to the top of the upper section 20. Thus, the base plate 12, the upstanding lower and upper side wall sections 18 and 20, and cover plate 22 form the cylindrical housing 10 in which the filter 40 is positioned. A leak check aperture 19 and associated fitting 21 are provided near the base of the lower housing section 18.

The upper housing section 20 and cover plate 22 are removably connected to the lower housing section 18 by means of a clamping arrangement. Several forms of such a clamping arrangement are possible, none of them being critical to the invention. In the presently preferred embodiment, a lower housing ring 28 surrounds the circumference of the lower housing section 18, and an upper overlapping housing ring 30 surrounds the circumference of the upper housing section 20. Housing rings 28 and 30 are welded to their respective sections 18 and 20. The upper housing section 20 engages the lower housing section 18 by means of these mating rings 30 and 28 which form a sealed engagement when connected by means of an O-ring 32. A plurality of lower flange brackets 34 and corresponding upper flange brackets 36 are welded respectively to the lower and upper housing sections 18 and 20 at points around their outer circumference. A clamping screw 38 and nut 39 releasably clamp the upper housing to the lower housing at these several bracket locations; and when tightened, the housing 10 is secure.

The filter 40 is an integral unit which fits into the housing 10 and is removable from it. Filter 40 includes a bottom end cap 42 having apertured nipples 44 and 46 extending into respectively the inlet and outlet apertures 14 and 16 in the base plate of the housing. The nipples 44 and 46 of the bottom end cap 42 fit snugly and sealingly within the apertures 14 and 16 in the base plate by means of suitable O-ring seals 48. An inner cylindrical core tube 50 of a plastic material, for example polypropylene, is sealed to the bottom end cap around its inlet

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aperture 44 with a sealant such as an electro-magnetically activated polypropylene adhesive sealer or similar suitable sealing composition. Core tube 50 stands upright from the bottom end cap forming an inlet channel 52 which leads
5 directly from the inlet piping 4. An outer cylindrical tube 54, concentric with core tube 50 and also of a similar plastic material, is also sealed to the bottom end cap 42 near its periphery and stands upright from the bottom end cap. A top end cap 56 of a plastic material such as
10 polypropylene is mounted and sealed atop the outer tube 54. The top end cap 56 of the filter abuts directly against the cover plate 22 of the housing, giving longitudinal support to the filter. A pair of sealing O-rings 60 surround the vent apertures 24 and 25 in the cover plate
15 22 and end cap 56 respectively at the interface between cover plate 22 and end cap 56. The sealing engagements of the bottom end cap 42 with the core tube 50 and the outer tube 54, and the sealing engagement of the top end cap 56 with the outer tube 54, are all represented by deposits 70
20 of sealant at the respective locations of connection.

A filter element 64 (see also FIG. 2) is a spiral wound roll of a sandwich including a flat filter sheet material 62 interleaved with a corrugated polymeric separator sheet 63. The corrugations provide spacing
25 between successive layers of the filter sheet 62, which spaces are axial flow channels for the liquid passing through the filter. Alternate axial channels 66 are blanked off at the bottom, while successive alternate axial channels 68 are blanked off at the top, as suggested by the
30 shade lines in channels 68, so that fluid enters at the top of the open-top channels 66 and leaves at the bottom of the open-bottom channels 68. Filter action is by way of radial flow, through the filter material 62, from the open-top channels 66 to the open-bottom channels 68 as indicated in
35 FIG. 3. The blanking of the ends of the flow channels is formed by a hot melt plastic.

Referring now to FIGS. 4 and 5, radial flow channels 65 are formed in the top end cap 56 (FIG. 4) by means

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of radial ribs 57 depending from the top end cap. Similarly, radial flow channels 69 are formed in the bottom end cap 42 (FIG. 5) by means of radial ribs 43 extending upward from the bottom end cap. Radial ribs 43 on the bottom end cap alternately extend partially inward from the outer radius, while successive alternate ribs extend partially outward from the inner radius to provide a circumferential flow path to the off-center outlet aperture 46 as well as radial flow paths from the open-bottom channels 68 through the range of their radial locations.

When a filter is to be changed, the fluid system will be shut down and drain caps 9 removed to drain off the liquid remaining in the filter. Then the cover plate 22 and upper housing section 20 are removed by loosening and removing the clamping screws 38. The filter 40 is then easily grasped and lifted out. If it is immediately turned upside down, the solid top end cap 56 will prevent any further dripping or draining of the dirty filter.

Little, if any, clean-up of the stainless steel housing will be required because the interior of the housing is not wetted by the liquid when the unit is in operation. If draining through the drain nipples 8 is completed before disassembly, the only wetting of the housing interior should be by incidental dripping when the filter unit is removed. It may be desirable, in order to promote the best possible drainage, to have the inlet and outlet piping installed such that there is a slight tilt of the entire unit toward the outlet pipe 6. This will aid the gravity flow of liquid residue to the outlet pipe 6 when the system is shut down.

A clean filter 40 is then inserted into the housing 10, and the cover plate 22 and upper housing section 20 replaced. As clamping screws 38 are tightened, the cover plate 22 is drawn down against the top end cap 56 and against O-rings 60. Thus, all seals, top and bottom, between filter 40 and housing 10 are made effective.

Some applications of the filter of this invention may not require venting, and therefore the venting

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arrangement shown at 26 may not be essential. Also, it is possible, but not presently preferred, that the inlet and outlet pipings can be reversed, i.e., piping 6 might be the inlet piping and piping 4 the outlet. Finally, while the unit is shown as simply mounted on permanent and stable piping, it may instead be fixed to a wall or other support structure for connection with more flexible piping.

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We claim:

1. A liquid filter apparatus for connection to inlet and outlet piping, including a housing connected to said piping and an integral filter unit removably inserted
5 into said housing:
said housing including:
 - a. a base plate having inlet and outlet apertures in registry with said inlet and outlet piping;
 - 10 b. an upstanding side wall;
 - c. a cover plate having a vent aperture therein and removably mounted relative to said base plate;said filter unit including:
 - 15 d. a bottom end cap having inlet and outlet apertures and adapted for sealing engagement with the respective inlet and outlet apertures of said base plate;
 - e. a cylindrical core tube surrounding the
20 inlet aperture of said bottom end cap and extending upwardly therefrom, said core tube effecting a continuation of said inlet piping;
 - f. a concentric cylindrical outer tube
25 extending upwardly from the periphery of said bottom end cap;
 - g. a top end cap mounted atop said outer tube, said top end cap having a vent aperture in registry with the vent
30 aperture in said cover plate; and
 - h. a cylindrical filter element disposed between said core tube and said outer tube; said filter element being axially displaced from said bottom end cap and
35 said top end cap, thus defining therewith respectively bottom and top radial flow channels;

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whereby said filter unit defines, exclusive of said housing, the liquid flow path through said apparatus from said inlet to said outlet apertures, and said housing provides structural support for said filter.

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2. A liquid filter apparatus as defined in Claim 1 in which said filter element is spirally wound to define alternate axial flow channels directly communicating respectively with said bottom and said top radial flow channels, whereby filter action is by way of radial flow from those axial channels communicating with said top radial flow channels to those axial channels communicating with said bottom radial flow channels.

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3. A liquid filter apparatus as defined in Claim 1 and in which said core tube and said outer tube are in sealing engagement with said bottom end cap, and said outer tube is in sealing engagement with said top end cap.

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4. A liquid filter apparatus as defined in Claim 1 and in which said side wall includes a lower housing section and an upper housing section, said housing further including releasable means to sealingly engage and disengage said upper and lower housing sections.

20

5. A liquid filter apparatus for connection to inlet and outlet piping, including a housing connected to said piping and an integral filter unit removably inserted into said housing:

25

said housing including:

30

- a. a base plate having inlet and outlet apertures communicating respectively with said inlet and outlet piping;
- b. an upstanding side wall extending from the peripheral region of said base plate;
- c. a cover plate mounted atop said side wall, said cover plate being removable relative to said base plate;

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said filter unit including:

- d. an upstanding cylindrical core tube and

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an outer concentric cylindrical tube extending between bottom and top end caps, said bottom end cap having inlet and outlet apertures in registry and in sealing engagement with respectively said inlet and outlet apertures in said base plate;

e. a filter element disposed between said core tube and said outer tube;

f. said bottom and top end caps each including axially extending ribs to create respectively bottom and top radial flow channels below and above said filter element; and

g. said filter element including a porous filter material defining a plurality of axial flow channels; some of said axial flow channels being open at their tops and closed at their bottoms to receive liquid from said top radial flow channel, some of said axial flow channels being closed at their tops and open at their bottoms to discharge liquid into said bottom radial flow channel, whereby filter action is by way of radial flow from those axial flow channels with open tops to those axial flow channels with open bottoms;

whereby said filter unit defines, exclusive of said housing, the liquid flow path through said apparatus from said inlet to said outlet apertures.

6. A liquid filter apparatus as defined in Claim 5 and further including means to vent air from said filter unit and means to drain liquid from said inlet and outlet piping.

7. A liquid filter apparatus as defined in Claim 5 in which said inlet and outlet apertures of said

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bottom end cap extend through axial nipples which in turn extend into respectively said inlet and outlet apertures of said base plate.

8. A liquid filter apparatus as defined in
5 Claim 7 in which said sealing engagement is effected by O-rings surrounding said axial nipples.

9. A liquid filter apparatus for connection to
inlet and outlet piping, including a housing connected to
said piping and an integral filter unit removably inserted
10 into said housing:

said housing including a base plate mounted on
said piping and apertured in correspondence therewith, an
upstanding side wall extending from said base plate, and a
cover plate mounted atop said side wall and removable
15 relative to said base plate;

said filter unit including a bottom end cap
apertured to correspond with said base plate, an inner
cylindrical cover tube and an outer concentric cylindrical
tube extending upward from said bottom end cap, a top end
20 cap mounted atop said outer tube, said inner and outer
tubes being in sealing engagement with said bottom end cap
and said outer tube being in sealing engagement with said
top end cap, a cylindrical filter element surrounding said
inner core tube and within said outer tube and axially
25 spaced from said top and bottom end caps to define there-
with respectively top and bottom radial flow channels;

said filter element being formed of a porous
filter material defining a plurality of axial flow chan-
nels, some of said axial flow channels being open at their
30 tops and closed at their bottoms, some of said axial flow
channels being closed at their tops and open at their
bottoms, whereby filter action is by way of radial flow
from those axial flow channels with open tops to those
axial flow channels with open bottoms.

10. An integral liquid filter unit for removable
insertion into a housing for positioning said filter unit
in operative engagement with inlet and outlet piping;

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said filter unit including a bottom end cap
apertured to correspond with said base plate, an inner
cylindrical cover tube and an outer concentric cylindrical
tube extending upward from said bottom end cap, a top end
5 cap mounted atop said outer tube, said inner and outer
tubes being in sealing engagement with said bottom end cap
and said outer tube being in sealing engagement with said
top end cap, a cylindrical filter element surrounding said
inner core tube and within said outer tube and axially
10 spaced from said top and bottom end caps to define there-
with respectively top and bottom radial flow channels;

said filter element being formed of a porous
filter material defining a plurality of axial flow chan-
nels, some of said axial flow channels being open at their
15 tops and closed at their bottoms, some of said axial flow
channels being closed at their tops and open at their
bottoms, whereby filter action is by way of radial flow
from those axial flow channels with open tops to those
axial flow channels with open bottoms.

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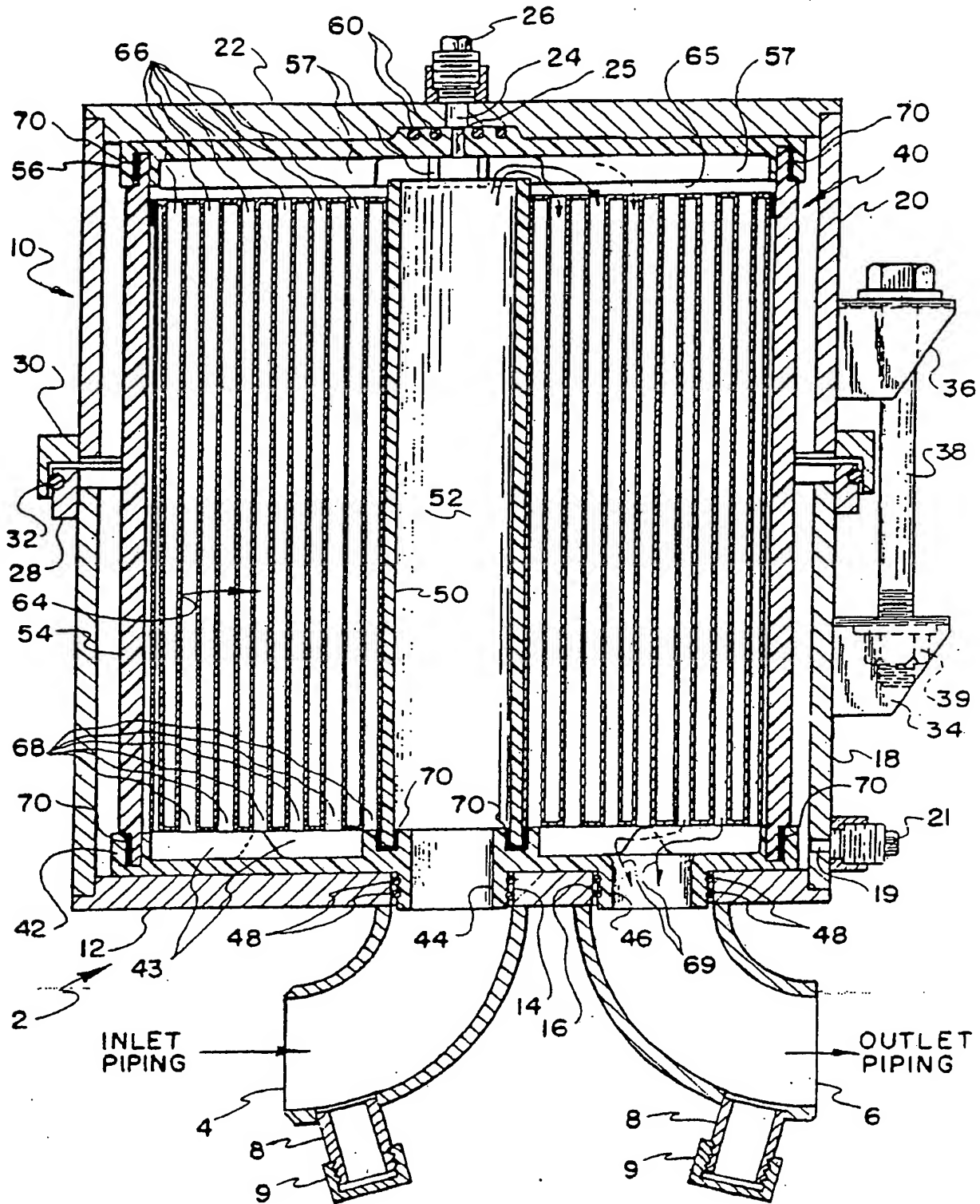


FIG. 1

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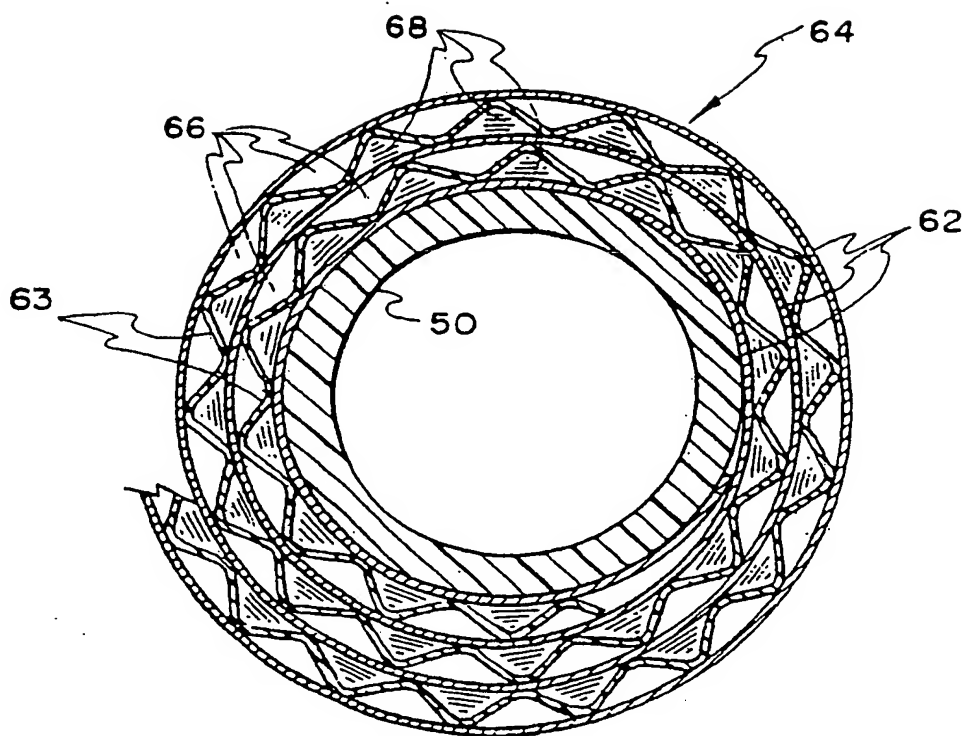


FIG. 2

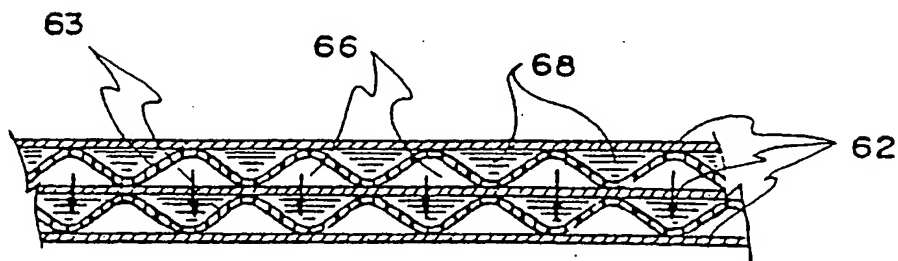


FIG. 3

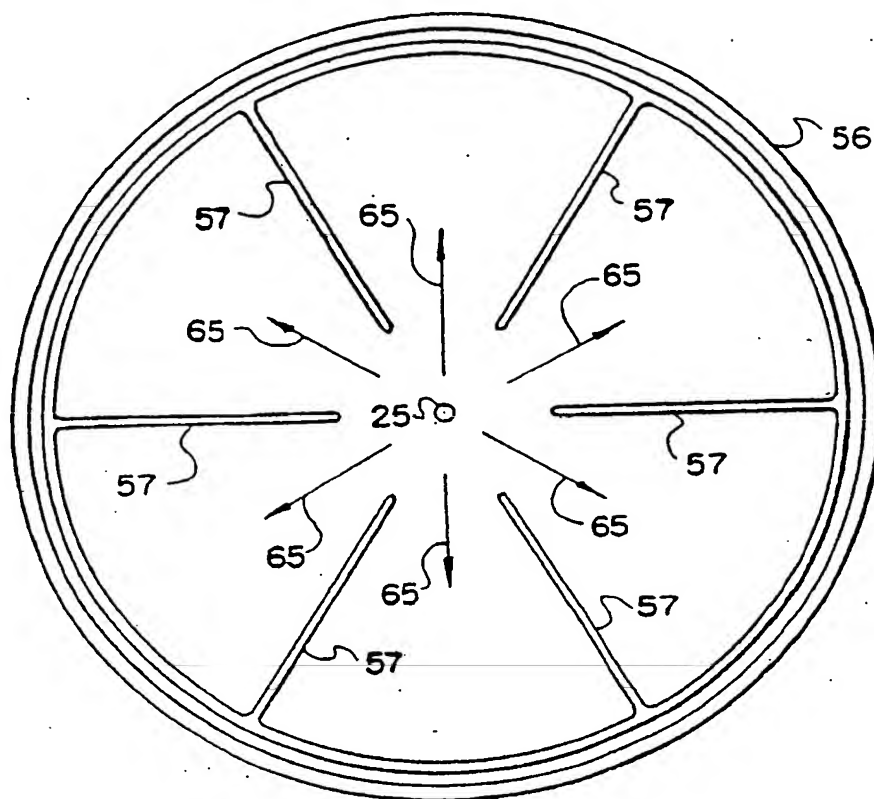


FIG. 4

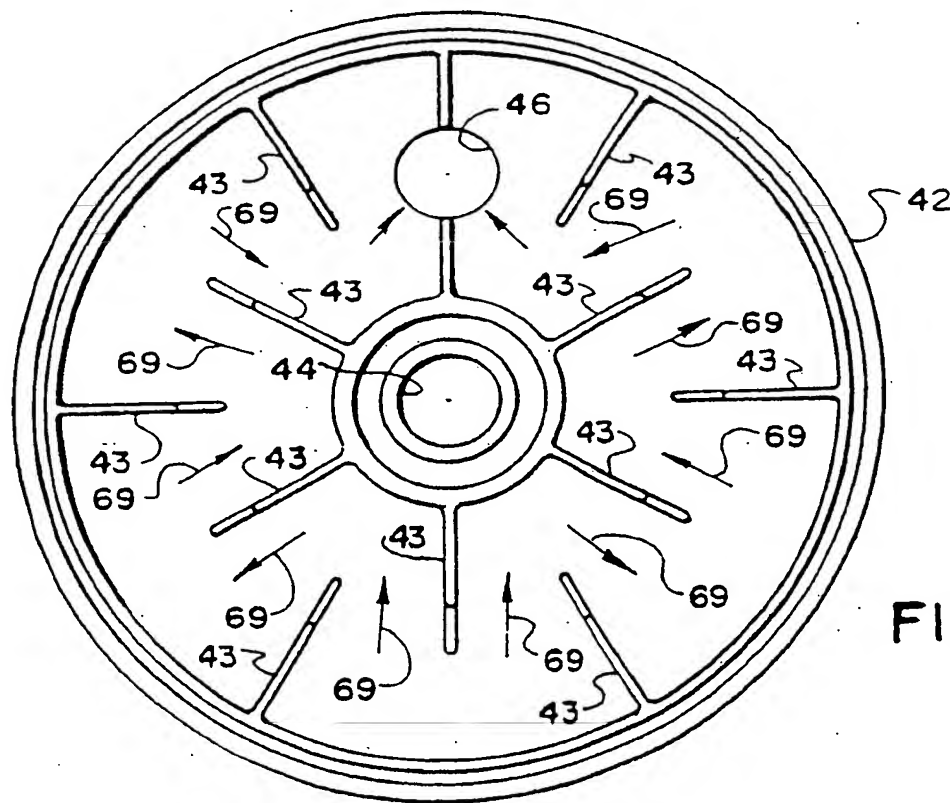


FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 87/02843

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC⁴: B 01 D 25/24; B 01 D 35/30; B 01 D 27/08

II. FIELDS SEARCHED

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Documentation Searched other than Minimum Documentation
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III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US, A, 4615812 (DARLING) 7 October 1986 see figures 2,4 --	1,3,5,9, 10
A	US, A, 2115577 (GOLDMAN) 26 April 1938 see figure 2 --	1,4,5,9, 10
A	GB, A, 1150126 (FRANTZ AND YEE) 30 April 1969 see figures 1,2,6,7 --	1-3,5,9, 10
A	US, A, 3056503 (ROOSA) 2 October 1962 see figure 1 --	1-3,5-7, 9,10
A	GB, A, 1159078 (A.M.F. CO.) 23 July 1969 see figures 1,2 --	1,3,5,7- 10
A	US, A, 3759388 (THOMASON) 18 September 1973 see figures 3,4 --	1-3,5,9, 10
A	FR, A, 2148726 (HERFIL CO.) 23 March 1973 see page 4, lines 1-5; figures 1-4 --	1,2,5,9, 10
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IV. CERTIFICATION

Date of the Actual Completion of the International Search

8th February 1988

Date of Mailing of this International Search Report

18 MAR 1988

International Searching Authority

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Signature of Authorized Officer

P. E. VAN DER PUTTEN

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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A	WO, A, 83/01582 (DONALDSON CO. INC.) 11 May 1983 see figures 1-4, 6	1, 2, 5, 9, 10
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

US 8702843

SA 19526

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDI' file on 04/03/88. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4615812	07-10-86	None	
US-A- 2115577		None	
GB-A- 1150126	30-04-69	None	
US-A- 3056503		None	
GB-A- 1159078	23-07-69	DE-A- 1536760	26-02-70
US-A- 3759388	18-09-73	US-A- 3880757	29-04-75
FR-A- 2148726	23-03-73	None	
WO-A- 8301582	11-05-83	FR-A- 2515526	06-05-83
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